

AMENDMENTS TO THE SPECIFICATION:

Please delete the current Abstract and replace it with the following Abstract:

Disclosed is a method, computer readable medium, and an apparatus for estimating a value of a vector of variables p in a mathematical model representing a physical process, where a state vector x of the model is estimated by a State Augmented Extended Kalman Filter, and where the vector of variables p represents one or more properties of the process and is representable by a function of the state vector x .

Please replace the paragraph beginning at page 1, line 14, with the following amended paragraph:

The invention relates to the field of process control. It relates to a method, computer program and data processing system for the estimation of process variables as ~~described in the preamble of claims 1, 8 and 9, respectively.~~

Please replace the paragraph beginning at page 1, line 21 and ending on page 2, line 22, with the following amended paragraph:

Mathematical modelling is an essential tool in modern industry. It makes possible a whole range of procedures for process control, planning, scheduling, optimisation, monitoring etc., where processes considered are technical or physical processes such as industrial production processes, power plants, mechatronic devices etc. The success of the above procedures hinges on the ability of the mathematical models to represent the physical reality at a needed degree of accuracy. The mathematical models incorporate a number of parameters. Some of these parameters have a physical meaning, e.g. mass, flow, temperature, force. Other parameters are

coefficients of given parameterised functional dependencies among physical properties of the process. For example, in a turbomachine, i.e. a compressor or a turbine, such dependencies are expressed by polynomials describing relationships such as

mass flow = f_1 (vane position, pressure ratio, rotor speed, etc)

efficiency = f_2 (temperature, mass flows, pressures, etc)

where f_1 and f_2 are static non-linear functions of the bracketed variables, which represent measured or estimated process states in the machine. Graphical representations of these functions are so called "compressor maps". Coefficients of polynomials replacing these functions are usually computed via least square fitting of experimental data. Usually only manufacturers have enough data to carry out the fitting at all relevant conditions. Moreover, the process of fitting is costly and cumbersome. During operation, not in a test set-up but at an arbitrary installation, it is difficult to measure accurately all the values entering the relationships f_1 and f_2 and therefore to deduce a suitable approximation.

Please replace the paragraph beginning at page 5, line 5 with the following amended paragraph:

That is, the process properties such as mass flow or efficiency *themselves* are estimated, and not polynomial coefficients for computing the variables from the ~~state~~ state. The surprising result is that this approach works and that the abovementioned disadvantages are overcome.

Please replace the paragraph beginning at page 15, line 16, and ending on page 16, line 7, with the following amended paragraph:

Another example of a polynomial approximation is found in Knud Rasmussen, "Calculation methods for the physical properties of air used in the calibration of microphones", Department of acoustic technology, Technical university of Denmark report PL-11b, 1997 (<http://www.dat.dtu.dk/docs/PL11b-RAP.PDF>) that can be found on the World Wide Web at [dat.dtu.dk/docs/PL11b-RAP.PDF](http://www.dat.dtu.dk/docs/PL11b-RAP.PDF) where the specific heat ratio of humid air is approximated as follows:

$$\begin{aligned}\kappa &= a_0 + a_1T + a_2T^2 + (a_3 + a_4T + a_5T^2)x_w + (a_6 + a_7T + a_8T^2)P + a_9x_w^2 + a_{10}P^2 \\ x_w &= \frac{H}{100} \frac{P_{sv}(T)}{P} f(P, T) \\ P_{sv}(T) &= \exp(b_0T^2 + b_1T + b_2 + b_3T^{-1}) \\ f(P, T) &= c_0 + c_1P + c_2T^2\end{aligned}$$

where $a_0, a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8, a_9, a_{10}, b_0, b_1, b_2, b_3, c_0, c_1, c_2$ are polynomial coefficients to be estimated. In the formulas above, κ is the specific heat ratio, T is temperature, P is pressure, x_w is a mole fraction of water vapour in air, P_{sv} is the saturation water pressure and H is the relative humidity in percentage. According to the invention, the polynomial for the specific heat capacity κ is replaced with one single augmented state and included in a larger model, for example in a model of a compressor, a turbine or a heat exchanger.